

Application No. 10/671,851
Response Dated March 28, 2007

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REMARKS/ARGUMENTS

Status of Rejection

As noted in the previous Response (e.g., page 10, second paragraph), there was considerable uncertainty over which references were being applied. One patent was referenced repeatedly, while the text referred to in the rejections appeared to at times be from a different patent. While the discrepancy did not appear to prevent the delivery of a Response, Applicant is concerned that the current action has been designated as "final", i.e., "...based on new grounds". It is respectfully requested that the Examiner reconsider the finality of this action.

Status of Claims

Claims 1, 3, 5-21, 23, 25 and 27-43 are currently pending in this case. Claims 2, 4, 24, and 26 have been canceled, without prejudice; and claims 22 and 44 have been withdrawn from consideration, pursuant to a Restriction Requirement. Claims 1, 3, 5-21, 23, 25 and 27-43 stand rejected.

Claim Rejections – Double Patenting

This issue relates to claims 1, 3, 5-21, juxtaposed with claims 23, 25, and 27-43. In brief, it appears to be the Examiner's position that claims directed to an "article" and a "composite" are effectively identical, in those instances in which the primary difference is the preamble itself. In the present instance, Applicant submits that there are differences between the subject matter of the two groups of claims. A "composite" typically (though not always) refers to a material or a monolithic shape, while an "article" refers to a end-product in a specific shape, e.g., a turbine blade. Nevertheless, if agreement is reached on other issues in prosecution, Applicant may be prepared to cancel claims which are arguably redundant, with the proviso that distinct and patentable subject matter is not sacrificed by such an action.

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Claim Rejections – 35 U.S.C. 103

Claims 1, 3, 5-9, 12-17, 23, 25 and 27-39 stand rejected under 35 U.S.C. 103(a), as being unpatentable over U.S. Patent 6,692,586, issued to Xu et al ("Xu"). (There is some discrepancy as to the listing of claims which are actually rejected in this section of the Office Action, since a slightly different set of claims is listed at the top of page 3 of the Office Action. While clarification is requested, the undersigned will attempt to form a response which can be directed to all claims listed). In general, it appears to be the Examiner's position that the subject matter of the referenced claims would be obvious to one skilled in the art. Many of the claims are compared with various sections of the Xu patent.

The present invention has been discussed in considerable detail in the previous Response. Thus, an exhaustive description of the invention is not necessary here. In brief, the invention is directed to niobium-based refractory metal-intermetallic composites (RMIC's), such as the niobium-silicide alloys, which provide an unusual combination of properties. The materials can withstand very high temperatures – much higher than the operating temperatures for traditional nickel-based superalloys. Moreover, the ductile metal phase (Nb-based) and the relatively brittle intermetallic phase (often Si-based) provide a very useful combination of mechanical properties over a wide range of temperatures.

As previously noted during prosecution, it can be very difficult to process RMIC's. However, the present inventors conceived a unique fabrication technique. A refractory metal precursor phase is first blended with a silicide precursor phase to form a powder blend. The blend is then consolidated and mechanically deformed at a first temperature level. The resulting material is then reacted at a second, higher temperature, to form both the metal phase and the intermetallic phase. This process can provide a greater degree of compositional and microstructural control. One important advantage of such control is the ability to obtain complex component geometries, critical for components such as high pressure turbine blades. Moreover, the fabrication can take place at relatively low temperatures, with a reduced need for time-consuming, post-process machining.

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The Xu reference had also been discussed in considerable detail in the first Response. In brief, Xu describes high-temperature braze materials, which contain one or more base elements such as Ti, Ta, Nb, Hf, Si, and Ge (element symbols used here). The compositions also include a secondary element selected from Cr, Al, Nb, B, Si, Ge, and mixtures thereof. (See col. 4, lines 9-26). The constituents are combined to form a braze composition, i.e., a lower-melting composition used to join articles made from higher-melting structural materials, like the RMIC's. While the composition of Xu may contain some elements which happen to be similar to some elements of the present invention, the overall braze material has nothing to do with the present invention. Xu fails to disclose or suggest the mechanical deformation/reactions steps for the refractory metal/silicide precursor, as in the present claims. Moreover, the Xu patent fails to suggest the higher-temperature reaction step recited in claim 1, wherein the metal-intermetallic phases are formed.

Thus, a point that Applicant has consistently tried to make remains dispositive: Xu is, in effect, describing two separate processes: 1) a process for making a braze composition suitable for high-temperature brazing; and 2) the brazing process itself. The first process does involve the blending of components, and some of the constituents are similar to constituents employed in Applicant's process. The second process in Xu involves the heating steps, as pointed out by the Examiner at column 8, line 55 et seq. However, those heating steps are part of the brazing process – not part of the first process, i.e., the manufacture of the braze material. Therefore, the Xu disclosure can in no way suggest Applicant's claimed process.

Near the bottom of page 3 of the Office Action, the Examiner appears to indicate that overlapping temperature ranges make the temperature regimen of the present invention obvious. Applicant respectfully disagrees. As noted above, the temperature specification in Xu relates to the brazing process – not to the preparation of the brazing material. Nothing in Xu suggests the inventive technique of blending a Nb/Ti/Mo-type material with a silicide precursor, and then consolidating and deforming the blend at a prescribed lower temperature, followed by a powder-blend reaction step at a prescribed higher temperature, to form an RMIC material.

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Instead, Xu's primary embodiments are clearly directed to the liquid-brazing of two articles, or the formation of joints in an article. (See, e.g., column 2, lines 10-20 – "brazing joint", "brazing repair"; column 3, lines 35-37 – "...substrate to be brazed"; Example 3, lines 65-67 – "brazing joints"). The continual reference to brazing compositions is understandable – that's the purpose of Xu's invention, and it has nothing to do with the preparation of RMIC materials.

Applicant has also reviewed the Examiner's points on page 4 of the Office Action, continuing to page 5. They relate mainly to compositional issues. Again, Applicant submits that the claimed compositions and those of Xu may include common elemental constituents, such as chromium, silicon, and niobium. However, this similarity has nothing to do with a showing of how the process steps of the two disclosures could in any way be similar.

The Examiner's points in regard to other sections of Xu also require comment. (See page 5 of the Office Action). Example 2 is cited, along with sections of columns 8 and 9, in regard to heating times. Again, though, Applicant must emphasize that those heating times relate to the brazing process – not the preparation of RMIC alloys. (See the title of Example 2: "Brazing Process...."). The alloys themselves could be said to relate to the articles being brazed by Xu, but that has nothing to do with the preparation of those articles.

On pages 5 and 6 of the Office Action, the Examiner also includes the Svedberg and Jackson patents in rejections of various claims. Each of these patents had also been discussed in earlier prosecution. In brief, Svedberg describes oxidation resistant niobium alloys, and their preparation. However, the reference has nothing to do with the preparation of a refractory-silicide composition, as in the present invention. As mentioned previously and described in the specification, the presence of the silicide phase is critical for providing a specific combination of strength and oxidation resistance over a wide-ranging temperature environment. Since the silicide phase is critical to the present invention, a reference which does not involve the phase cannot really be applied to the pending claims. Moreover, while Svedberg may refer to protective coatings applied over the refractory material (see Office Action, last paragraph on page 7),

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the mere mention of these types of "overlayers" does not supply the other missing features of the claimed invention, i.e., the unique preparation steps for the underlying RMIC article.

Jackson describes specific types of RMIC composites, based on a combination of elements, including Nb, Si, Ta, Ti, and Hf, as well as other elements (col. 3, lines 33-38). While this patent certainly describes niobium silicide composites, the reference never suggests the processing steps of the present invention. The preparation description provided in column 6 is a general teaching which does not address the problems which prompted the discovery of the present invention. Moreover, while Jackson mentions the concept of "grading" (and Applicant has graded embodiments, as in claim 40), the patent only describes a graded surface layer (col. 3, lines 25-29; col. 4, lines 33-41; claim 29). The reference never describes the preparation of a graded composite by a sequence of specific deformation/reaction steps, as in the present invention.

Thus, Applicant submits that a combination of any of these three references does not suggest the present invention. There appears to be some misunderstanding in regard to the primary reference, Wu; while both Jackson and Svedberg are silent as to key steps in Applicant's claimed process.

Conclusion

It is respectfully requested that the Examiner again review the primary reference, Xu, as it relates to the specific process steps of the present invention. It is hoped that such a review will result in the allowance of the present claims, which had been amended previously. The undersigned would be very interested in discussing any remaining issues with the Examiner, if an interview might resolve those issues.

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